

### Remarks

Claims 1, 4-7, 9-13 and 15-16 are pending in the application.

Claims 1, 5, 7, 10-13 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atia et al. ("Demonstration of Return-to-Zero Signalling ...", IEEE Lasers and Electro-Optics Society, 12<sup>th</sup> Annual Meeting, 8-11 Nov. 1999), hereinafter "Atia" in view of Clausen et al. (U.S. Patent No. 6,832,050 B1), hereinafter "Clausen."

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen applied to claims 1, 5, 7, 10-13 and 15-16 and further in view of Ono et al. (U.S. Patent No. 6,097,525, hereinafter "Ono").

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen as applied to claims 1, 5, 7, 10-13 and 15-16 and in further view of Tzukerman et al. (U.S. Patent No. 6,724,829, hereinafter "Tzukerman").

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen as applied to claims 1, 5, 7, 10-13 and 15-16 and further in view of Fukuchi (U.S. Patent No. 5,745,613, hereinafter "Fukuchi").

Each of the various rejections and objections are overcome by various amendments and arguments that are presented.

Any amendments to any claim for reasons other than as expressly recited herein as being for the purpose of distinguishing such claim from known prior art are not being made with an intent to change in any way the literal scope of such claims or the range of equivalents for such claims. They are being made simply to present language that is better in conformance with the form requirements of Title 35 of the United States Code or is simply clearer and easier to understand than the originally presented language. Any amendments to any claim expressly made in order to distinguish such claim from known prior art are being made only with an intent to change the literal scope of such claim in the most minimal way, i.e., to just avoid the prior art in a way that leaves the claim novel and not obvious in view of the cited prior art, and no equivalent of any subject matter remaining in the claim is intended to be surrendered.

Also, since a dependent claim inherently includes the recitations of the claim or chain of claims from which it depends, it is submitted that the scope and content of any

dependent claims that have been herein rewritten in independent form is exactly the same as the scope and content of those claims prior to having been rewritten in independent form. That is, although by convention such rewritten claims are labeled herein as having been "amended," it is submitted that only the format, and not the content, of these claims has been changed. This is true whether a dependent claim has been rewritten to expressly include the limitations of those claims on which it formerly depended or whether an independent claim has been rewriting to include the limitations of claims that previously depended from it. Thus, by such rewriting no equivalent of any subject matter of the original dependent claim is intended to be surrendered. If the Examiner is of a different view, he is respectfully requested to so indicate.

#### **Rejection Under 35 U.S.C. 103(a)**

##### **Claims 1, 5, 7, 10-13 and 15-16**

Claims 1, 5, 7, 10-13 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atia in view of Clausen. The rejection is traversed.

Claim 5 is cancelled. The phase modulator of claim 1 is inherently capable of performing phase shift keying (PSK), differential phase shift keying (DPSK) and quadrature phase shift keying (QPSK). Claim 1 is amended to incorporate the features of claims 7 and 9. Claims 7 and 9 are cancelled. Claim 1 is also amended for clarity.

According to MPEP §2143.03: "All words in a claim must be considered in judging the patentability of that claim against the prior art" (*quoting, In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)). In addition, to establish a *prima facie* case of obviousness the prior art reference (or references when combined) must teach or suggest all elements of the subject claim. *In re Wada*, 2007-3733 (BPAI Jan. 14, 2008) (*citing, CMFT, Inc. v. Yieldup Intern. Corp.*, 349 F.3d 1333, 1342 (Fed.Cir. 2003)). The Office Action fails to establish a *prima facie* case of obviousness because the combination of Atia and Clausen fails to teach or suggest all the limitations of Applicants' invention of at least independent claim 1.

The Office Action asserts that Atia teaches an apparatus including a phase modulator for modulating the optical phase of pulses within a sequence of return-to-zero

pulses. The Office Action asserts that Clausen teaches a system with dispersion compensating devices and teaches the advantage of using a short duty-cycle. The Office Action concludes that the combined teachings of Atia and Clausen render claim 1 obvious. Applicants respectfully disagree.

Claim 1 is amended to include the feature of “a wavelength division multiplexer adapted to combine an output signal of said at least one modulator with other optical phase modulated signals having optical carriers with different wavelengths.” This feature was previously found in claim 9, which is now cancelled. Claim 1 is further amended to include the additional feature of “a dispersion managed optical transmission medium for transmitting an output wavelength division multiplexed signal of said wavelength division multiplexer.” The preamble of claim 1 is also amended to clarify that the apparatus is for use “in long haul transmission.” This feature was previously found in claim 7, which is now cancelled. Applicants submit that entry of the amendment is proper and is fully supported by the original disclosure.

Applicants submit that the combined teaching of Atia and Clausen does not render currently amended claim 1 obvious because the references fail to teach or suggest all elements of the claim. Specifically, neither Atia nor Clausen involves a wavelength division multiplexed (WDM) system and thus the references do not disclose at least the feature of claim 1 “a wavelength division multiplexer adapted to combine an output signal of said at least one modulator with other optical phase modulated signals having optical carriers with different wavelengths.”

Atia teaches single channel return-to-zero (RZ) carrier pulses modulated by on-off keying (OOK) or differential phase shift keying (DPSK) to improve receiver sensitivity in an optically preamplified receiver. Atia does not teach that RZ-DPSK signals are combined in WDM format. Atia also does not teach that the RZ-DPSK format is used in long haul wavelength division multiplexed (WDM) transmission.

Furthermore, Atia does not suggest or imply such usage. As stated in Applicant’s specification, and as known to one of ordinary skill in the art, there is no predictability of success when attempting to bridge the substantial gap between optical single channel and WDM applications, especially when using high bit rates for long haul transmission:

While various techniques have been attempted to reduce or eliminate the effects of noise and fiber nonlinearity, these techniques have had varying degrees of success. Some techniques have proven useful in single wavelength channel systems, but do not work well in the context of WDM systems, in which many different wavelengths are combined in a single optical transmission medium.

Use of high bit rates in conjunction with long haul and ultra-long haul (ULH) transmission, particularly in the environment in which multiple channels are combined in a WDM or DWDM system, has been additionally difficult, due to both the worsened nonlinear impairments and the increased amplifier spontaneous emission (ASE) noise, which leads to degradation of pulses as they propagate through an optical fiber path from a transmitter to a receiver and various undesirable inter-channel effects, such as inter-channel XPM and FWM.

(Spec. p. 1-2, Background of the Invention) (emphasis added). *See* MPEP 2143.02 “Reasonable Expectation of Success is Required.” Thus, in a WDM application additional transmission penalties such as inter-channel XPM and FWM are relevant. Success in a single channel application is no predictor of whether a similar WDM system will also be successful.

Atia decidedly does not teach or disclose that the use of RZ-DPSK or other PSK formats reduce the inter-channel four way mixing penalty (FWM) because Atia is not a WDM system. Thus, for all of the foregoing reasons Atia does teach or suggest at least the feature of claim 1 “a wavelength division multiplexer adapted to combine an output signal of said at least one modulator with other optical phase modulated signals having optical carriers with different wavelengths.”

Clausen fails to bridge the substantial gap between Atia and Applicants’ invention of at least independent claim 1. Clausen teaches a method and system for dispersion management of RZ modulated pulses by means of “tedon” transmission whereby RZ pulses are propagated with a short duty cycle, the short duty cycle purposely designed to cause the pulses to spread as far apart as quickly as possible. Pre-dispersion compensation is provided by the introduction of pre-chirp. (Clausen col. 3 lines 64-67). Clausen also contemplates the use of fibers with a large chromatic dispersion characteristic to facilitate greater pulse spread/dispersion. (Clausen, col. 7 lines 29-30).

Like Atia, there is no teaching or suggestion in Clausen that the apparatus or method is used in a WDM application. In fact, Clausen only suggests functionality with respect to a single channel system. For example, Clausen states at col. 7 lines 24-26: "In summary, non-linear impairments due to intrachannel interactions in schemes involving ultrashort pulse (tedon) transmission with random bit sequences have been studied" (emphasis added). Clausen also does not disclose any form of phase shift keying (PSK, DPSK, QPSK). Thus, Clausen cannot teach or suggest the advantage that DPSK or other PSK formats have in reducing the inter-channel FWM penalty in a WDM application. Applicants therefore submit that Clausen does not teach or suggest the feature of claim 1 "a wavelength division multiplexer adapted to combine an output signal of said at least one modulator with other optical phase modulated signals having optical carriers with different wavelengths."

As such, the combined teachings of Atia and Clausen do not teach or suggest each and every feature in Applicants' claim 1. Claim 1 is therefore patentable over these references. (The rejection of claim 9, the features of which are now incorporated into claim 1, over Atia in view of Clausen and in further view of Fukuchi is addressed separately below).

Independent method claim 16 recites similar relevant features to those found in independent claim 1, an apparatus claim. For at least the same reasons as recited above with respect to claim 1, claim 16 is also patentable over the combined teaching of Atia and Clausen.

Finally, since claims 10-13 and 15 depend from claim 1 and recite additional limitations therefrom, these claims are also patentable for at least the reasons discussed above with respect to claim 1.

Therefore, the rejection of claims 1, 10-13 and 15-16 should be withdrawn.

#### **Claims 4, 6 and 9**

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen further in view of Ono. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen and further in view of Tzukerman. Claim 9 is

rejected under 35 U.S.C. 103(a) as being unpatentable over Atia and Clausen and further in view of Fukuchi. The rejections are traversed.

Claims 4 and 6 are cancelled. The modulator of claim 1 is inherently capable of performing phase shift keying (PSK), differential phase shift keying (DPSK) and quadrature phase shift keying (QPSK). Claim 9 is cancelled and is incorporated in claim 1. Because the features of claim 9 are now incorporated in claim 1, Applicants herein respond to the Office Action's rejection of claim 9.

The Office Action recognizes that Atia and Clausen do not teach or disclose a wavelength division multiplexer, but asserts that this missing feature is supplied by Fukuchi. Applicants acknowledge that Fukuchi discloses a wavelength division multiplexer and a WDM system, but strongly disagree that such disclosure may be properly combined with Atia and Clausen to render Applicants' claim 1 obvious.

To support a prima facie obviousness rejection under 35 U.S.C. §103, "the prior art can be modified or combined as long as there is a reasonable expectation of success." MPEP 2143.02(I). However, as explained above there is no predictability of success when transitioning from an optical single channel application to an optical WDM system. (Spec. p. 1-2, Background of the Invention). While Applicants agree that a wavelength division multiplexer is a common structure well known to one of ordinary skill in the art, it is not obvious to use RZ-DPSK or other RZ-phase shift keying format in a long haul or ultra long haul WDM system where there is no predictability of success. Furthermore, there is no suggestion or motivation found in the prior art (Atia, Clausen, or Fukuchi) that would suggest to one of ordinary skill to create the apparatus as embodied in claim 1. Fukuchi discloses WDM with non-return-to-zero (NRZ) phase encoding and, as explained in Applicants' specification, "the desire to have constant intensity in every WDM channel has lead to NRZ-DPSK [as in Fukuchi], rather than RZ-DPSK [this application]. It was not until recently did we realize that constant intensity is not necessary and that RZ-DPSK has significant advantages over NRZ-DPSK in LH and ULH transmission..." (Spec. p. 9, middle par.). Thus Applicants submit that Fukuchi teaches the opposite of the invention as embodied in claim 1 and would not suggest to

one of ordinary skill to combine the WDM system of Fukuchi with Atia and Clausen to arrive at Applicants' claim 1. *See generally* MPEP 2143 and MPEP 2143.02.

Applicants therefore submit the Office Action fails to establish a prima facie case of obviousness. *See* MPEP 2143.02(I). As such, the rejection should be withdrawn.

### **Claims 21-28**

Claims 21-28 are newly presented claims which depend from independent claim 1 or independent claim 16. Applicants submit that entry of the new claims is proper and is fully supported by the scope of the original disclosure. For example, claims 21 and 25 are directed to dispersion management in the optical transmission medium. Support is found in prior versions of claims 1 and 16 which claimed for example "a dispersion managed optical transmission medium; wherein dispersion management is provided by..." (claim 1, Applicants' Response to Office Action dated March 10, 2008). Support for the features of claims 22 and 26 is found in the immediately prior version of claim 7, the specification p. 7 last 2 paragraphs-p. 8 first par. 1, and in Fig. 7. Support for the features of claims 23 and 27 are found in the specification at p. 7, pars. 1-2 and in Figs. 6(a)-(b). Support for the features of claims 24 and 28 of an optical fiber with "high chromatic dispersion" is found in a prior version of claim 1 which states, "said pulses disperse very quickly as the propagate along said transmission medium," (Applicants' Response to Office Action, dated Sept. 17, 2007) and the discussion of pseudo-linear or quasi-linear transmission at p. 8 lines 11-22 of Applicants' specification.

Since claims 21-28 depend from independent claim 1 or 16 and the rejection of claims 1 and 16 have been overcome as described above, the dependent claims are likewise patentable. Therefore, allowance is respectfully solicited.

**Conclusion**

It is respectfully submitted that the Office Action's rejections have been overcome and that this application is now in condition for allowance. Reconsideration and allowance are, therefore, respectfully solicited.

If, however, the Examiner still believes that there are unresolved issues, the Examiner is invited to call Eamon Wall at (732)530-9404 so that arrangements may be made to discuss and resolve any such issues.

Respectfully,

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